



# STRING BOX



***Connection Box & Monitoring***



# Installation and user manual

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The manufacturer reserves the right to modify the described product in any moment without notice.*

# ICONS



DANGER!!

This icon warns you about a procedure that if not correctly executed can lead to serious accident or death.



WARNING!!

This icon warns you about a procedure that if not correctly executed can lead to damage to the equipment.



NOTICE!!

This icon indicates important info about the equipment.




## Individual Safety Equipment

During maintenance operations is forbidden to operate without Individual Safety Equipment indicated below.

The installation or maintenance personnel must NOT wear garments with wide sleeves, laces, belts, bracelets or other dangerous garments, especially if metallic.

Any long hair must be collected in order to not to be a danger.

The following icons represent the individual safety equipment to be worn. The equipment should be determined and chosen in relation to the kind of danger (especially the electric one) to be faced.

	Accident prevention footwear Use: ALWAYS		Protective goggles Use: ALWAYS
	Protective garments Use: ALWAYS		Helmet Use: in case of presence of suspended loads
	Insulated protective gloves Use: ALWAYS		



## Definition of *operators* and *technicians*

The personnel doing ordinary maintenance on the equipment are defined as “operators”. These personnel are aware about operating and maintenance modes of the equipment. These personnel must have the following requirements:

He/she has done a training to be enabled to operate according to current safety standards in relation to the electrical shock danger

He/she has done training on Individual Safety Garments and on basic First Aid

The personnel intended to install, first activation and to possible extraordinary maintenance are defined to be “technicians”.

These personnel must possess the operator’s requisites, and moreover:

He/she must be trained by the manufacturer (or by a deputy)

He/she must know the installation, assembly, repair and service modes; he/she must also have a specific technical qualification.

In general he/she has done a technical or specific training on use and security maintenance of the equipment.



## Emergency Actions

General information follows.

### **First Aid**

Follow corporate regulations and traditional first aid procedures.

### **Fire Fighting Measures**



Don't use water for fire fighting, but only fire extinguishers especially made for electrical and electronic equipments. Some equipment when in fire can release toxic fumes into the atmosphere: during fire fighting always use a respirator.

Thank you for choosing our product.

AROS is specialized in the development and production of equipments for statically converting energy. The "String Box" is a high quality product carefully designed and constructed to ensure the best performance.

## GENERAL WARNINGS



This manual contains the description of the use, installation and startup of the String Box. Read carefully this manual before installation or use. Due to the information contained about use of the equipment, the manual must be preserved with care; it must be examined before any operation on the equipment itself.

### Operating Instructions



This equipment is intended for professional use only, in industrial or commercial environments. The relay connections must be done with shielded electrical wire.

### Warning



This product is intended for sale to professional installers only. In order to prevent electrical noise, some installation restrictions or additional devices are possible.

## SECURITY RECOMMENDATIONS TO FOLLOW DURING INSTALLATION AND USE OF THE EQUIPMENT.

- The very first thing to do is to connect the ground wire to the clamp with the symbol



- The equipment must NOT operate without ground connection.
- The equipment must be installed and used according to the instructions contained into this manual
- The equipment has ELECTRICAL PARTS ALWAYS LIVE, the **operators** and the **technicians** must be adequately trained on operations on ELECTRICAL CIRCUITS ALWAYS LIVE, and must always wear INDIVIDUAL SAFETY EQUIPMENT
- Inside the equipment are always present dangerous voltages, even with the switch in open position. In order to safely access the equipment, disconnect all the strings coming from the PV array, always wearing the individual safety equipment.

The technician must strictly follow the indications related to the installation and maintenance of the equipment:

- Always use insulated tools
- Always use individual safety equipment
- Respect the polarity
- If necessary, substitute the fuses, using same type.
- Always follow the local existing legislation in order to correctly dispose the removed parts
- Do not deactivate security devices, do not ignore alarms and warnings, being these described into this manual or highlighted with plates or labels on or within the equipment.
- Promptly substitute the security warning plates or labels when unreadable.
- Use the equipment with mounted protections and the front door closed. During maintenance of the equipment never remove at the same time both transparent protections on the power boards.

- To modify, manipulate or in any way change the structure of the equipment is in any case forbidden without manufacturer's authorization.
- All the maintenance operations must be written on a special logbook; any operation must have date and time, the nature of the operation, name of the operator and all the useful information.
- When all the maintenance operations are over, a careful check must be done, in order to do not forget any tool or extraneous material inside the equipment.
- In case of faults or malfunctions the local dealer or the manufacturer must be contacted; only qualified technicians can do the necessary repair operations.
- It's exhaustively forbidden to wash the electrical parts, inside or outside the equipment.
- Both storage and installation places must respect the environmental requirements reported in this manual.

## **CE Marking**

The equipment described in this manual adheres to the following directives:

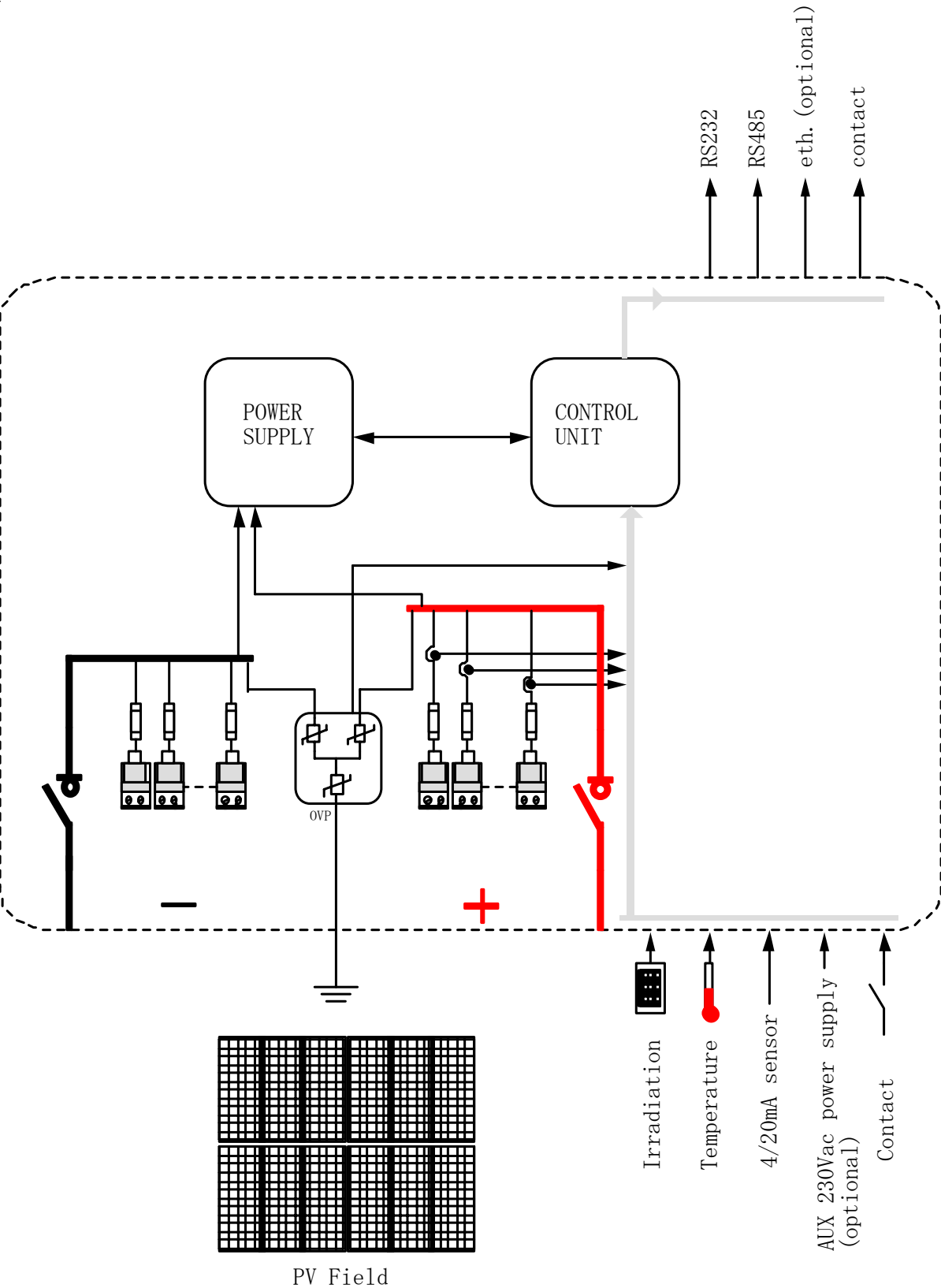
LV Directive 2006/95/EC.  
EMC Directive 2004/108/EC.

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## Summary

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STRING BOX general scheme and main connections available

The String Box is equipment that allows the parallel connections of the strings of a PV field; at the same time the String Box protects the strings with a fuse.

A sophisticated monitoring system within the String Box checks the status of any measure channel.

The key features of the String Box are:

- Parallel connection of (up to) 16 strings by 9A each (8 channels)
- Local and remote indication of status and alarm conditions
- RS232 and RS485 connections
- One SLOT connection for expanding communication (e.g. Ethernet board)
- Proprietary communication protocol and MODBUS RTU, both available on all the communication ports, no configuration necessary, hot-swap.
- Wide configurability of the monitoring parameters using the available software
- Local history log of alarms and status
- Protection fuses for each couple of inputs, 900Vdc on positive and negative
- For each input is possible to connect wires up to 16mm<sup>2</sup>
- Output switch, with optional release coil, used for inverter detachment
- Monitored discharger, used against over-voltage situations, protected against over-currents, easy to restore thanks to removable cartridges.
- Direct input power from PV field or from auxiliary
- Insulated digital inputs for local monitoring
- Insulated analog inputs for environmental sensors (2xPT100, 0-10V, 4-20mA)
- Configurable digital outputs with free contacts
- IP65 protection degree for external environment.

## CONFIGURATION SOFTWARE

This manual refers to String Box configuration software; this software is not provided with the equipment, but is downloadable from the manufacturer's web site or from the following site, in the Photovoltaic Section:

<http://www.aros.it>

The software is available for Windows only; within the same page is possible to download the software manual, in pdf format.

## INSTALLATION PLACE

The String Box equipment has been designed for external installation. For the installation choice, read the following notes:

- The String Box must be installed with wire connection side facedown.
- The String Box can be wall mounted, using the accessories provided. Be sure the wall chosen is able to withstand the weight.
- The mounting surface must not be flammable (e.g.: wood)
- Although the equipment is designed for external environments, it's necessary to protect it from direct sunlight; otherwise the internal temperature could damage the components.
- Do not install in places exposed to hot air.
- Do not install in spaces too narrow: these could obstruct the normal maintenance operations and the necessary air exchange.
- Leave an empty 30cm all around the equipment.
- The temperature of the installation environment must be within:

-20 ÷ +45°C (operating)

-20 ÷ +60°C (storage)

## BEFORE YOU BEGIN

When you receive the equipment verify that packaging is not damaged.

Pay attention when removing the packaging in order to avoid scratches.

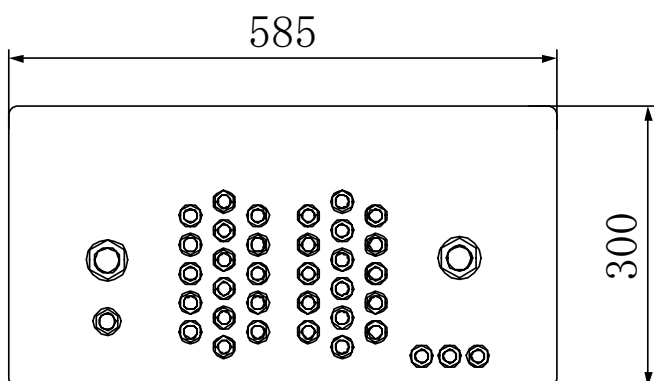
The String Box must be handled with care, any bumps and falls could damage the equipment.

This manual is provided with the String Box. The manual must be carefully preserved and must be examined before any operation on the equipment.

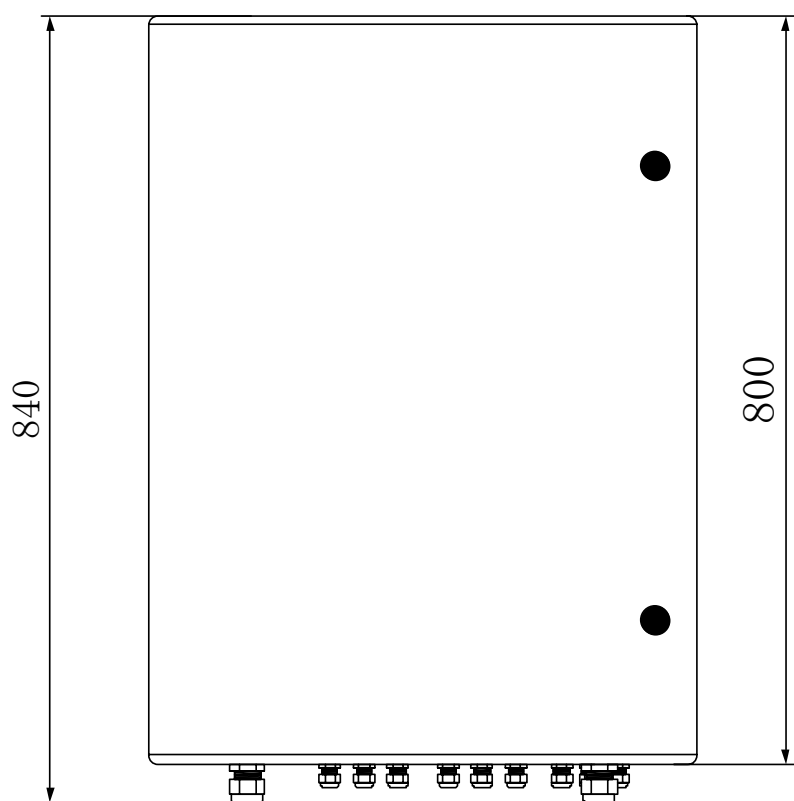
Packing list:

- String Box
- This manual
- Wall mounting installation kit (4 wall mounting accessories and 4 screws)
- 20 caps for cable gland kit (M16)
- Additional complete cable gland kits (6xM16 + 2xM32)

## DIMENSIONS AND WEIGHT



Bottom view



Front view

[Dimensions in mm]

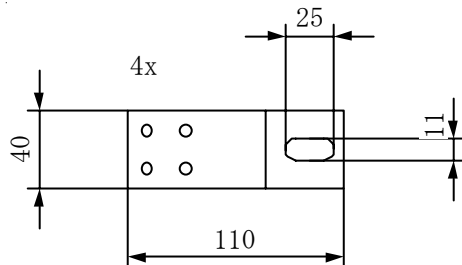
The String Box standard configuration weight is 27 Kg (59,52 lb)

## WALL MOUNTING

The String Box can be wall mounted. The wall mounting kit is composed by 4 rods and the necessary screws.

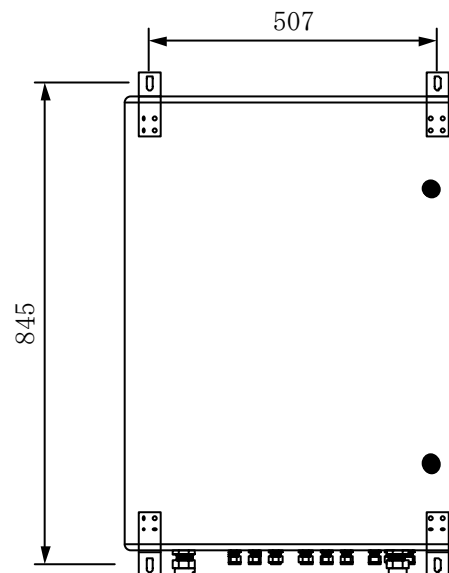
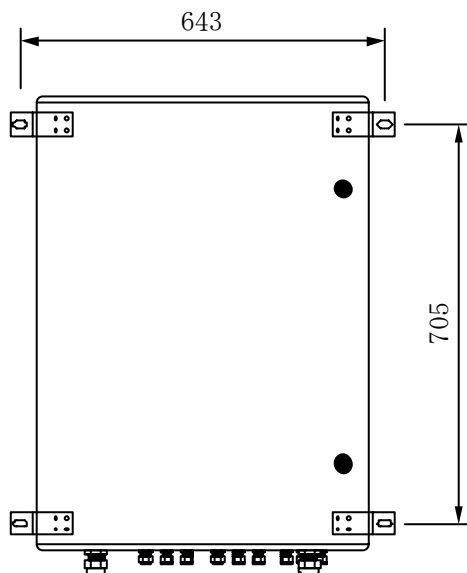


**WARNING:** All the mounting rods and screws must be used. The wall mounting screws are not included in the kit and should be chosen depending on the wall solidity.



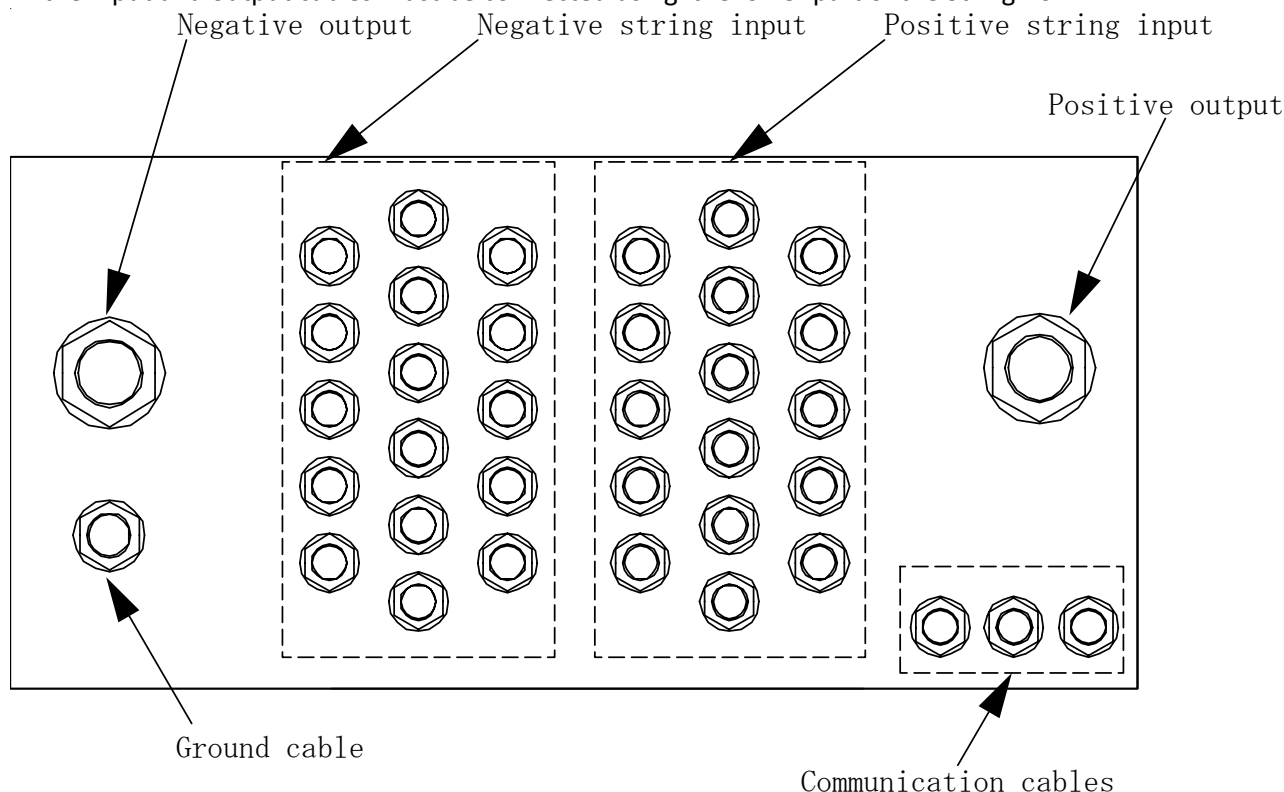
### WALL DRILLS

(Dimension in mm)



## INPUTS AND OUTPUTS

All the input and output cables must be connected using the lower part of the String Box



In detail the following connections are available:

### **Ground connection:**

To connect the ground cable, use the cable gland capable to accept cables with external diameter from 5 up to 12 mm. Internally the ground cable can be fastened to the M8 screw, so the cable should be prepared with a suitable crimp loop.

### **PV Field connections:**

For the string connections, the equipment has 2x16 cable glands (16 for positive, 16 for negative) for cables with diameter from 4 up to 10 mm. The maximum section for the cables connectable to the internal connections is 16 mm<sup>2</sup>.

If some inputs are not used, close the cable glands with the caps supplied with the String Box.

### **Output cables connection:**

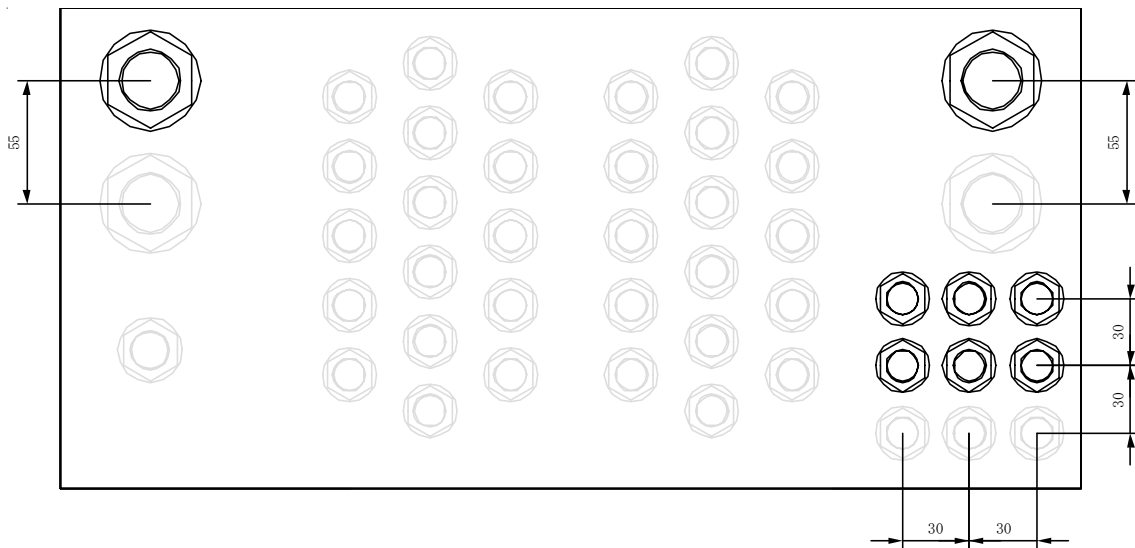
To connect the String Box to the inverter, there are two cable glands (indicated as Positive output and Negative output), for cables with external diameter from 11 to 21 mm. Internally the cables can be fastened to the M8 screws, so the cables should be prepared with suitable crimp loops.

Two more cable glands are supplied for those installations where two parallel cables for each polarity are needed. See the following figure for a correct drilling in this case. The diameter of the drill hole to install the cable glands is 32 mm.

### **Communication and power cables connection:**

There are 3 cable glands on the String Box that must be used for the communication cables, for the environment sensors and for the auxiliary power (optional). The external diameter for these cables must be within 4 to 10 mm.

If needed, it's possible to drill the bottom side of the String Box to increase the number of cables to connect. See the following figure for a correct drilling in this case. The diameter of the drill hole to install the cable glands is 16 mm.



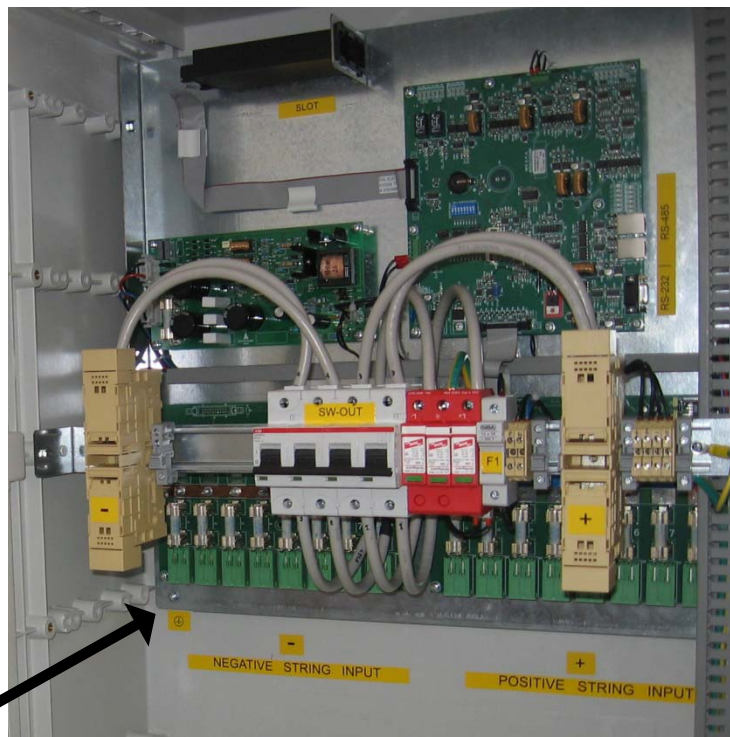
Optional cable glands placement

## GROUND CONNECTION



**DANGER:** The very first connection to be made on the String Box is the ground cable. Apart from security reasons, this connection grants the proper operation of the overvoltage dischargers within the equipment.

For this purpose a ground cable with minimal 25 mm<sup>2</sup> section must be connected to the correct screw (see below).



Ground cable connection

## POWER SUPPLY

The String Box needs a power supply in order to evaluate measures and to communicate.

This power supply can be provided by the PV field or optionally by an auxiliary 230Vac (+/- 20%).

In the factory configuration the String Box is configured to be supplied from the PV field, if PV field voltage is greater than 200 Vdc.

In order to use the auxiliary power supply apply the following procedure:



**DANGER: Follow this procedure BEFORE connecting the PV field and the auxiliary power supply to the String Box.**

- Verify that the output switch SW-OUT is in the OPEN position
- With a multimeter verify that no dangerous residual voltages are present on the positive and negative terminals
- Locate the power supply board inside the String Box and remove the transparent security cover. (See picture below, where you see the default configuration).
- Disconnect the cables connected to J1 and J2 and swap positions, as shown in the second picture.
- Restore the transparent security cover.
- Apply 230 Vac on the terminals on the DIN bar as indicated in the third figure.

J1 connector  
(Red & black)

J2 connector  
(Blue & black)



PV field powers the equipment (default)

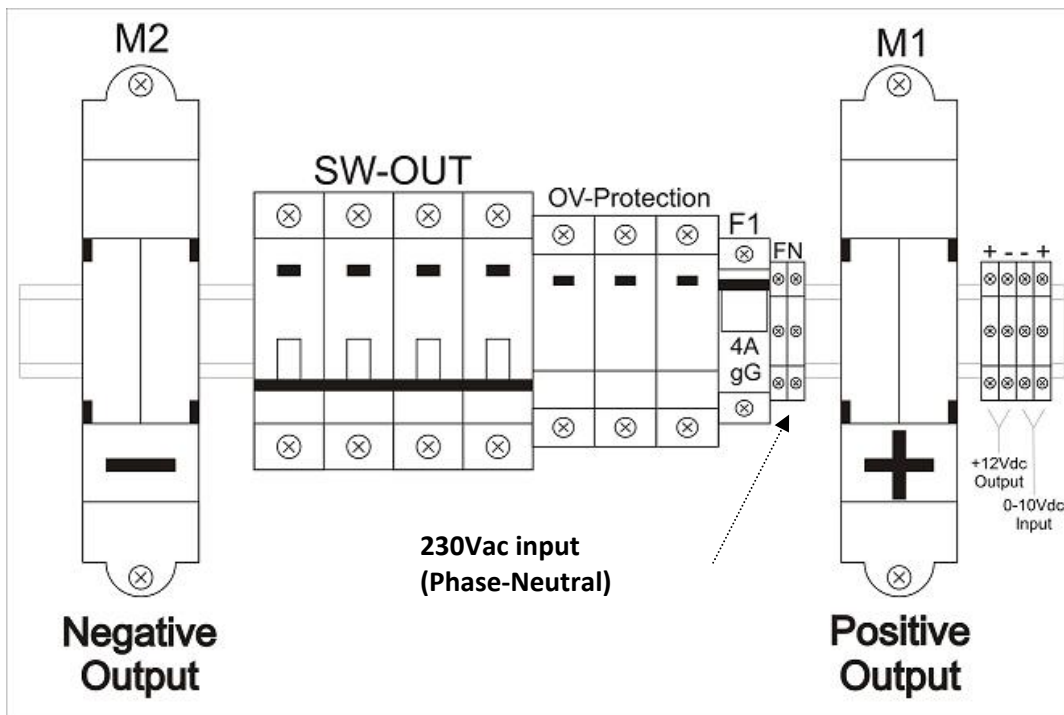
J1 connector  
(Blue & black)

J2 connector  
(Red & black)



Auxiliary 230 Vac powers the equipment





Terminals for auxiliary 230 Vac power supply

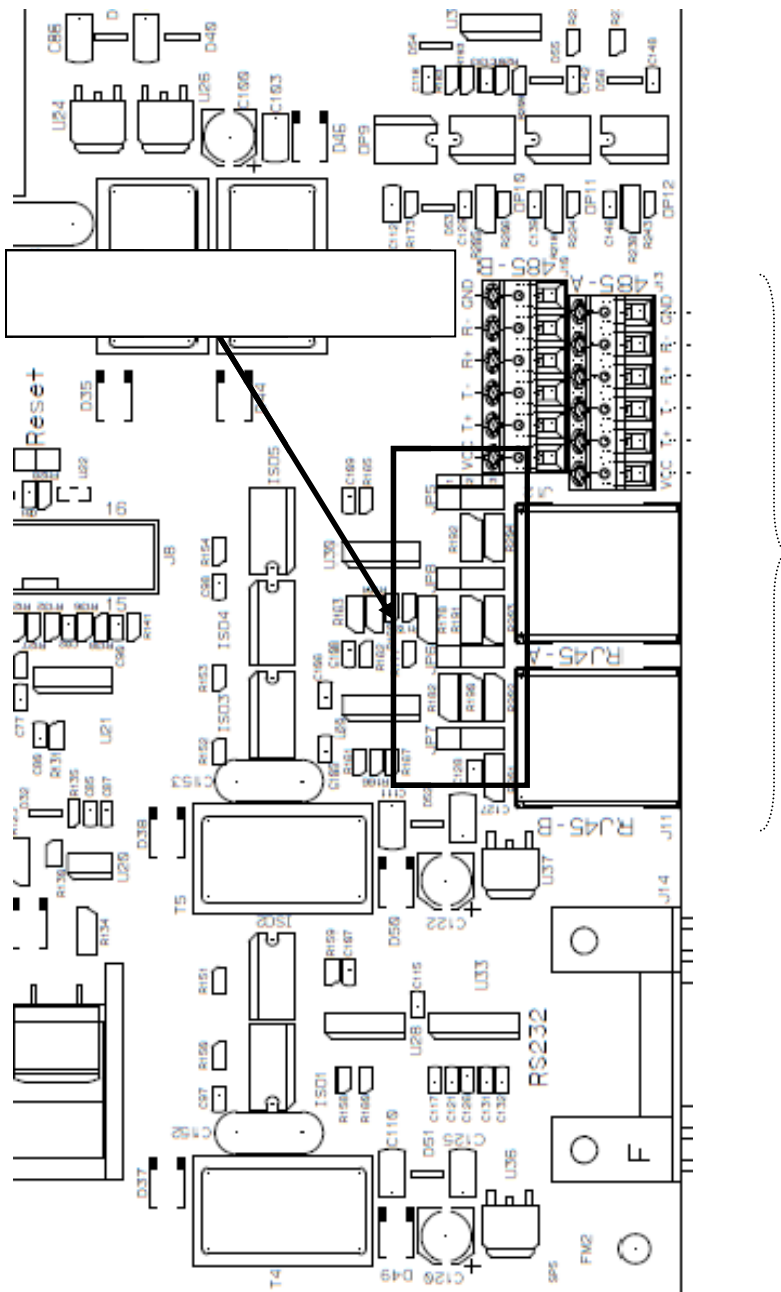


**WARNING:** The auxiliary power input is protected by a 4A fuse (F1), 10x38mm. If it's necessary to replace the fuse, use one with the same kind.

## COMMUNICATIONS

The String Box has many connection options. These connections are available into the microprocessor board (or control board), located at the upper side of the equipment.

In the following picture there is a view of the board, and the possible connections:



The RS232 port is a female DB9 connector; this connector allows a single point-to-point connection of a pc with the String Box and it allows configuration and monitoring.

The connection cable is a standard RS232 DB9 cable.

The RS485 port allows the String Box to be connected to a communication bus where more equipments and inverters can be present.

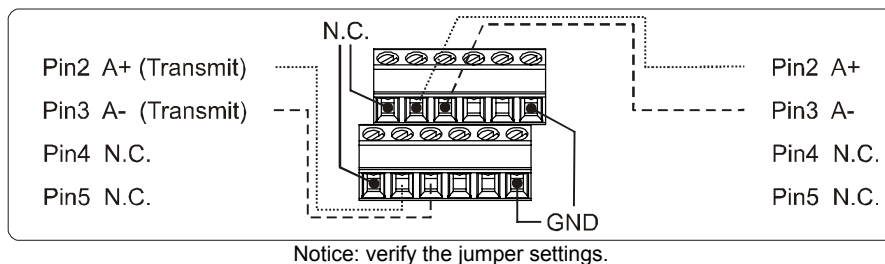
In order to make this connection work properly, see the following picture:

2 wire connection without termination	2 wire connection with termination	4 wire connection without termination	4 wire connection with termination

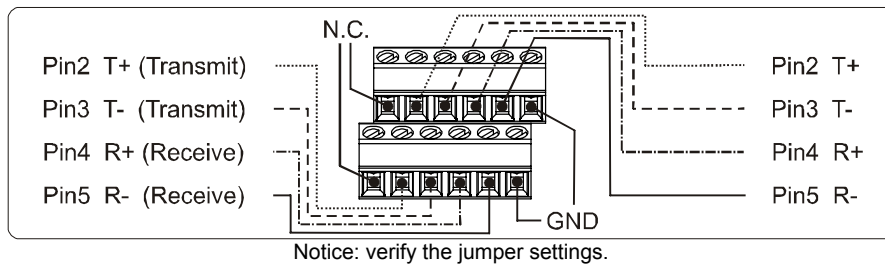
The RS485 connection can be done using the screw connectors or the RJ45 connectors; all the connectors are connected in parallel, so any combination of two in-and-out can be chosen.

See the following pictures for the two or four wires 485 connections:

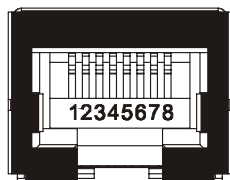
#### 2-wire connection with screw connectors



#### 4-wire connection with screw connectors



#### RJ45 connector pinout



PIN	2 wires	4 wires
1	N.C.	N.C.
2	N.C.	N.C.
3	N.C.	R+
4	A+	T+
5	A-	T-
6	N.C.	R-
7	GND	GND
8	N.C.	N.C.

#### Optional SLOT connection

The String Box offers an additional expansion slot in order to use optional communication cards. See proper communication card documentation for a detailed explanation.



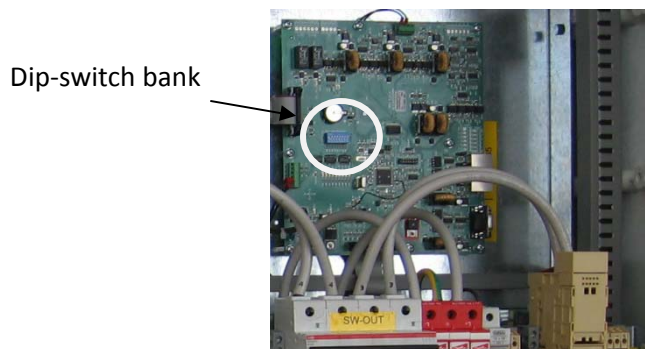
**WARNING:** In order to avoid damage to equipment and communication card, use cards specifically designed for use in conjunction with the String Box.

## STRING BOX ADDRESS

The String Box address can be configured using the SW1 dip-switch. Equipments on the same bus must not have the same address, so it's necessary to verify that also the inverters connected on the same RS485 bus have all different addresses.

To change the address of the String Box, use the following procedure:

- Locate the microprocessor card inside the String Box
- On the card locate the SW1 dip-switch bank, numbered from 1 to 8. Warning: the correct numbering is always in the serigraphy on the card.



- Set the correct address using binary encoding:

SW (serigraphy)	1	2	3	4	5	6	7	8
Value	1	2	4	8	16	32	64	-

The real address is the sum of all values set to ON position, so if you set to ON the dip switches 1 and 4, the String Box address is 9.

This address is used for all the communication ports (RS485, RS232 and SLOT) and for both Sunvision and Modbus protocol. The valid addresses range from 1 (just switch 1 to on) to 127 (all switches from 1 to 7 ON).

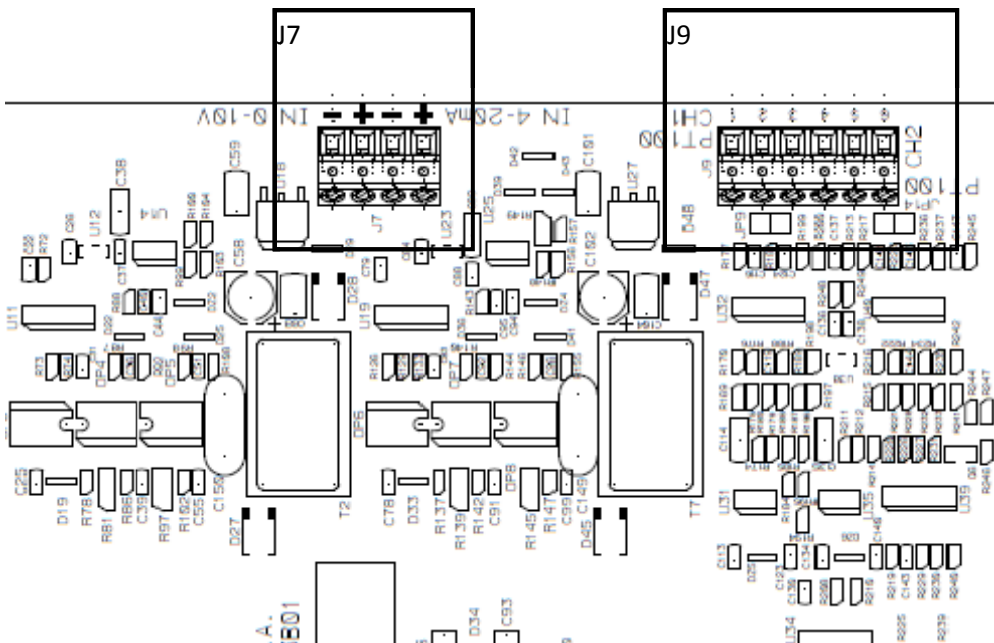
NOTE: The switch 8 is reserved for future use.

## MEASURES AND ALERTS, INPUTS AND OUTPUTS

The String Box has some analog inputs to connect external sensors. Specifically available:

- Two (2) PT100 analog inputs with 2 or 3-wire connection (J9 connector). These inputs are galvanically isolated respect to the card's electronic.
- One (1) 4-20 mA analog input, J7 connector. This input is galvanically isolated and can be configured by software.
- One (1) 0-10V analog input, J7 connector. This input is galvanically isolated and can be configured by software; the default configuration is for a solar radiation sensor in range 0-1200W/m<sup>2</sup>. For convenience there is a 12Vdc on the same connector for the power of the solar radiation sensor.

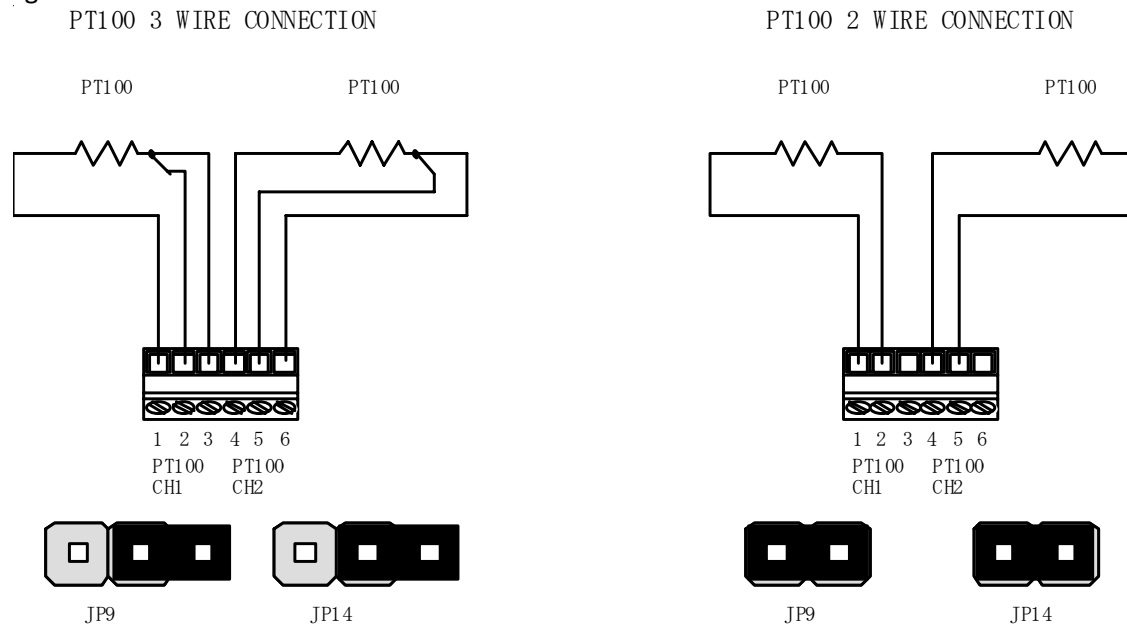
In the following figure the two connectors J7 and J9 are highlighted; they are located on the microprocessor card.



### PT100 input

The PT100 sensor connection to the J9 connector can be done in 2 or 3-wire configuration (this ensures greater accuracy in measuring the temperature, compensating the voltage drop)

The two configurations can be chosen using the jumpers located close to J9 connector, as the following figure shows:

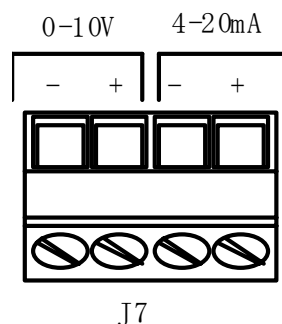


Mixed configurations are allowed (one channel configured as a 2-wire, the other one as a 3-wire).

### Analog inputs

Two generic analog inputs are present on J7 connector, one is suitable for voltages between 0 and 10V, the other one allows 4-20 mA transducers to be connected. The values acquired are transformed by the String Box into physical quantities. The configuration of such transformation is possible using the “Configuration and monitoring software”, see the software manual.

#### ANALOG INPUT

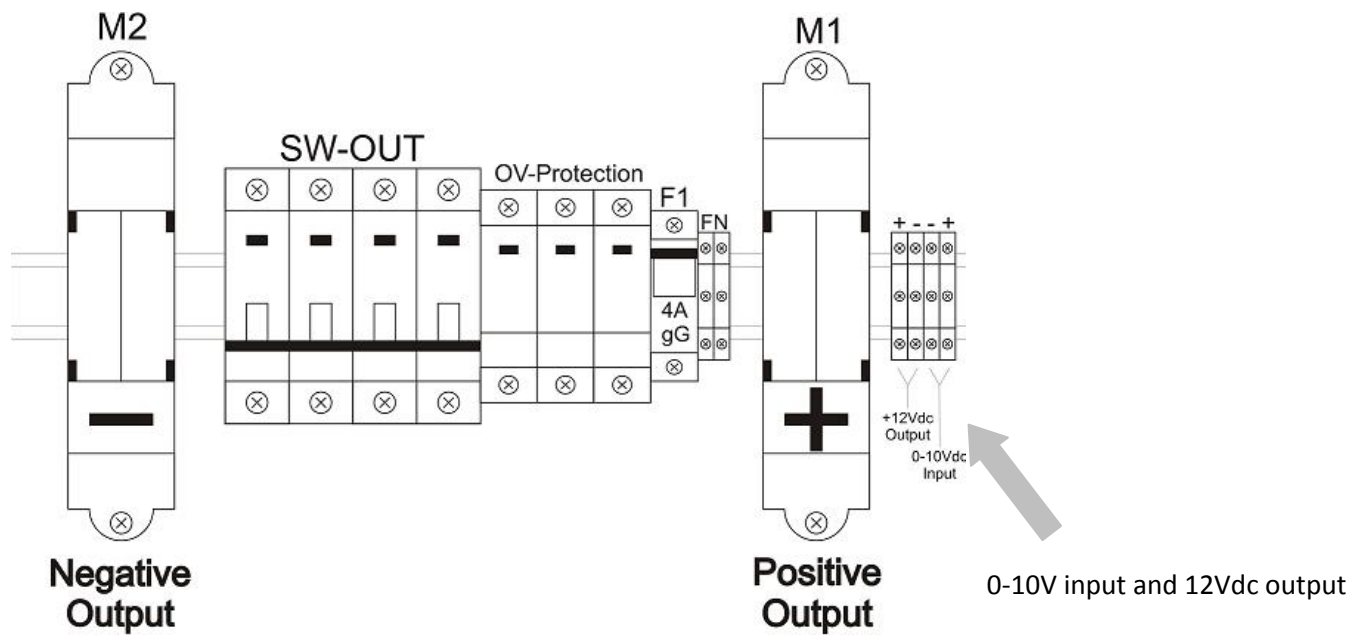


### 4-20 mA input

This configurable input by default will show 4 mA with 4 mA of input current and 20 mA with 20 mA input current. With the software this input can be fully re-configured, see software manual for details.

### 0-10V input

For an easy cable connection, the 0-10V input is located directly on the DIN-mounted screws.



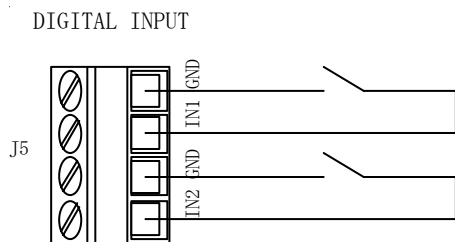
In the default configuration this input is configured as a solar radiation sensor in range 0-1200W/m<sup>2</sup>. See software manual for details.

Close to the 0-10V input there is also an auxiliary 12Vdc that can be used for the power of the radiation sensor.



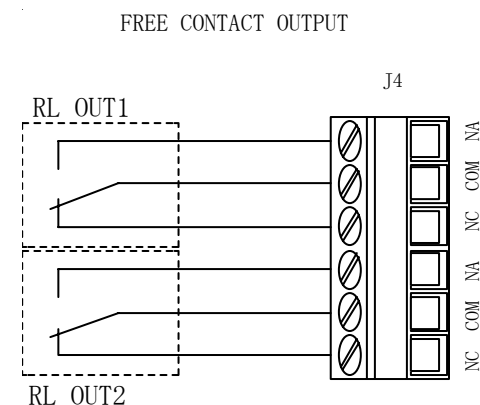
**NOTICE:** The 0-10V input is galvanically isolated respect to the rest of the card's electronics and to the 12V available on the screws. In order to allow correct operation of the solar radiation sensor is necessary to shorten the power negative and the negative of 0-10V.

## Isolated digital inputs



On J5 connector of the CPU card two digital isolated inputs are available. The status of these inputs is checked by the String Box and can be associated to an alarm. The default behavior the alarm is generated when this input is closed, but using the configuration software this can be changed (see flag “inverted logic”). This can be done for each input independently.

## Digital outputs (relays)



On J4 connector of the CPU card two free contacts relays are available. See the figure to see the position of the contacts (this figure shows the relays in a not-excited state) Using the configuration software is possible to assign a specific alarm to one or both the relays. See software manual for details.

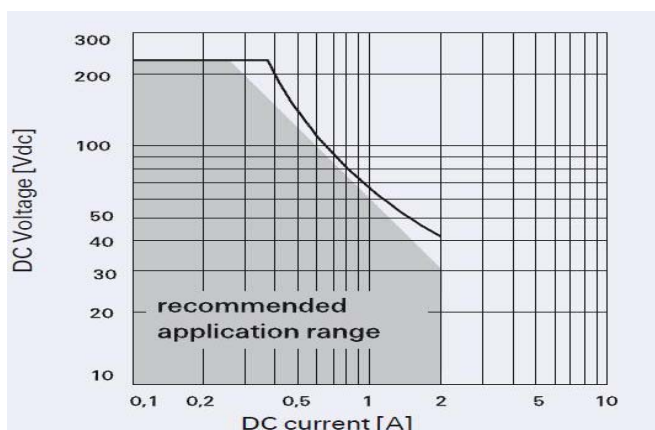
The default configuration is the following:

RL OUT1: is related to the OR of the following alarms:

- String alarms
- Null current persistence
- Overvoltage discharger in alarm

RL OUT2: is related to ALL the available alarms:

- String alarms
- Null current persistence
- Overvoltage discharger in alarm
- Power supply voltage alarm
- Isolated digital input 1
- Isolated digital input 2
- Real time clock alarm
- Internal memory alarm
- Analog voltage reference alarm
- Calibration error
- Auxiliary contact closed
- Link alarm



### RELAYS MAXIMUM LOAD

The graph we report here shows the maximum load (current) that the relay can bear, in relation to the applied voltage. For example with an applied voltage of 30V the maximum current is 2A, whereas with 200V the maximum current is 0.3A.



## INVERTER CONNECTION

The power cables going to the inverter must be connected on the bar screws of the DIN rail, front side of the String Box. The polarities indicated must be respected. See the large picture located on the inner side of the front door.

For each polarity an M8 pin is available; two cables of max 95mm<sup>2</sup> can be connected using the correct lug with hole.



**DANGER:** This equipment has internal parts always connected to the PV field and/or inverter (always live). Any operation on the String Box should be performed by a qualified technician only; these personnel must be adequately trained to operate on circuits ALWAYS LIVE; they must wear the proper INDIVIDUAL SAFETY EQUIPMENT.

DOUBLE CHECK THE POLARITY OF THE CONNECTIONS IN ORDER TO AVOID EQUIPMENT, PV PANELS AND INVERTER DAMAGE.



**DANGER:** The cables bringing power to the inverter can be LIVE if connected to other String Box equipments (more than one String Box can be connected to the same inverter). Before to operate on such cables, always open the switches of the other String Box equipments and the switches of the inverter. ALWAYS verify that no dangerous voltages are present on the operated parts (a digital multimeter with proper full scale can be used for this purpose).

## STRING CONNECTIONS

The String Box has 8 independent measure channels with 18A maximum current; each channel is protected by a 900V/20A fuse.

To each channel is possible to connect two cables, typically two strings of the PV field. For each polarity of the input strings a unipolar cable with diameter from 4 to 10mm must be used. The cable terminals are compatible with cables with section between 0.75 mm<sup>2</sup> and 16 mm<sup>2</sup>.



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DOUBLE CHECK THE POLARITY OF THE CONNECTIONS IN ORDER TO AVOID EQUIPMENT, PV PANELS AND INVERTER DAMAGE.

The cable terminals for the strings of the PV field have connectors that can be detached from the power board in order to help the connection/isolation of one or more strings to/from String Box.

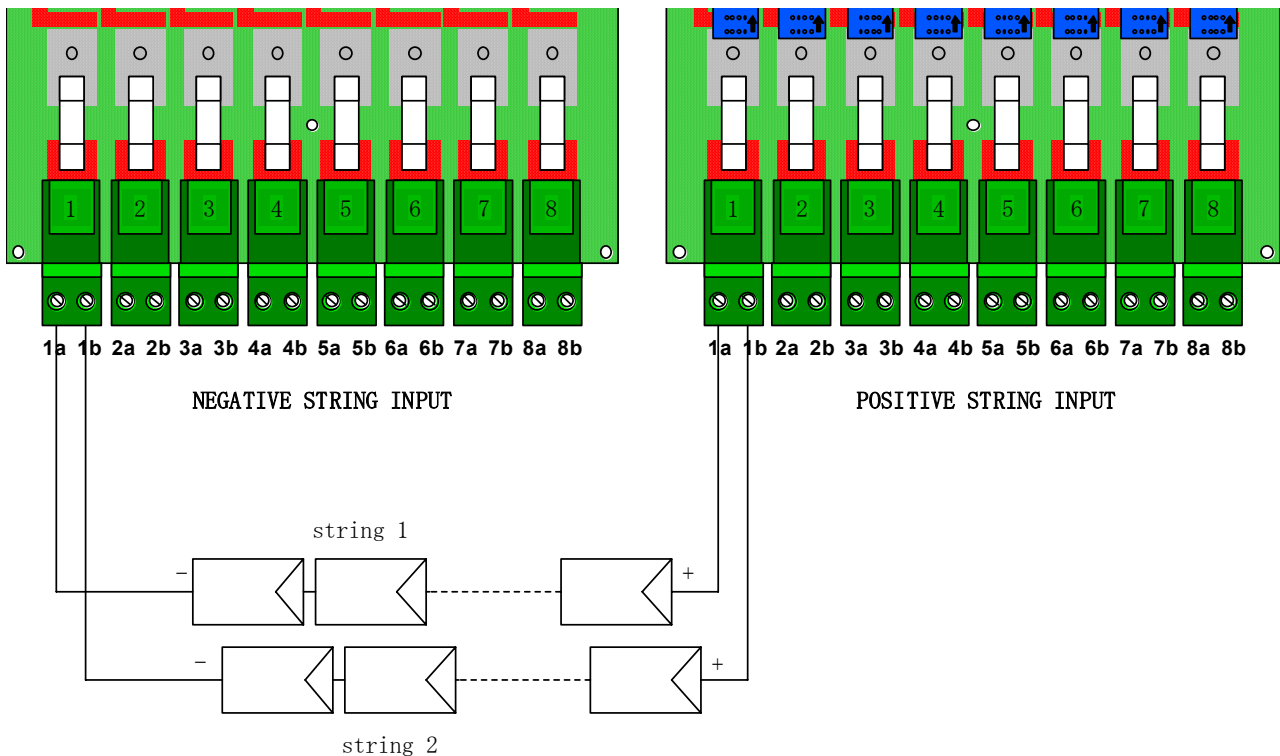


**DANGER:** When a cable terminal must be connected/disconnected to/from the power board, the current must be NULL. Before to connect/disconnect a cable terminal on/from power board, double check that the inverter is off and that output switch of the String Box is open.



**WARNING:** The positive and negative string terminals must be connected, carefully respecting the polarity, to the cable terminals on the two power boards.

When connecting the cables, always respect the cable terminals numeration, e.g. connect the positive of string 1 to the cable terminal 1a of the “positive” board and connect the negative of the same string to the cable terminal 1a of the “negative” board.



**WARNING:** If not all the inputs are used, it's necessary to close all the cable holes with the supplied caps; this ensures the level of protection designed.

## OPERATION

When all the connections are done and all the transparent security devices are set, it's possible to close the output switch in order to connect the PV field to the inverter.



**DANGER:** before to close the SW-OUT output switch, be sure that no operator is working on the cables connecting the String Box to the inverter; also be sure that no short circuits are present.

When the PV field voltage is above 200 Vdc or when auxiliary power is used, the equipment is powered and the string monitoring is started.

### Default configuration

By default the String Box monitors all the inputs with the same number of strings. Moreover, the strings have all the same current features, the same exposure and shading.

By default the String Box monitors from 6:00 to 21:59 of every day of the year.

Three key monitoring parameters are defined:

- **Tolerance (percentage, TOLL%):** is the maximum percentage of deviation of a measuring channel respect to the channel with maximum current beyond which an alarm condition arises. The default value is 20%.
- **Intervention time (TIME\_ALL):** is the time (in seconds) for which the alarm condition must persist before it is actually generated and sent to the remote control. The same interval time is applied when there is a return from alarm condition.
- **Minimum intervention threshold (percentage, MIN%):** is the percentage of current below which the comparison between the strings is not performed: if the current value of the maximum current string is below this value, the monitoring is not performed. After two days in this null current

condition, an alarm is generated ("null current persistence"). The default value is set to 10% of the scale.

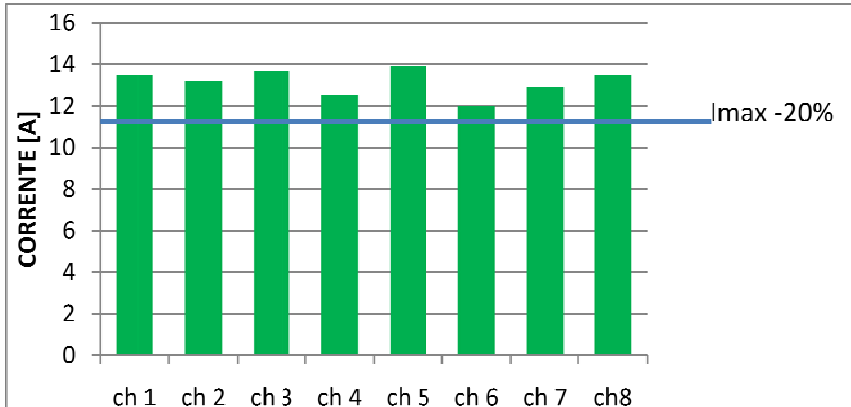
In the following examples we simulate the connection of 16 strings to the String Box; different possible situations are showed: normal operation, alarm situations.

An example of configuration change is also shown.

#### Example 1:

The currents measured are:

ch1	ch2	ch3	ch4	ch5	ch6	ch7	ch8	channel
13,5	13,2	13,7	12,5	13,9	12,0	12,9	13,5	[A]

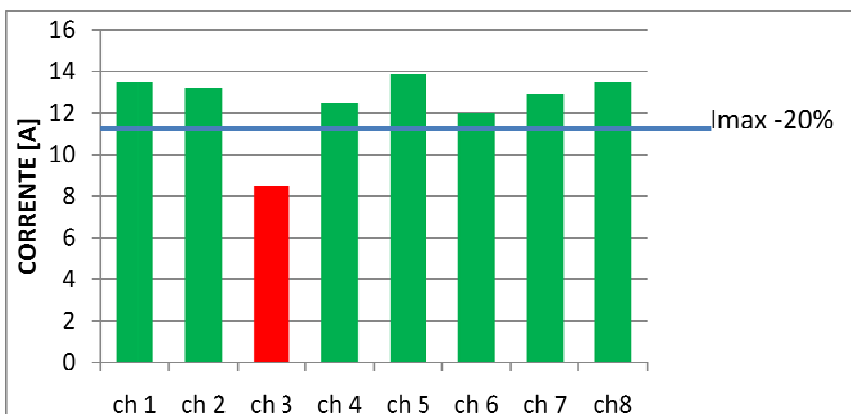


The maximum current is 13,9A, tolerance is 20%, so the alarm threshold is 11,1A. In this example all the current are above this threshold, so no alarm is present.

#### Example 2:

The currents measured are:

ch1	ch2	ch3	ch4	ch5	ch6	ch7	ch8	channel
13,5	13,2	8,5	12,5	13,9	12,0	12,9	13,5	[A]

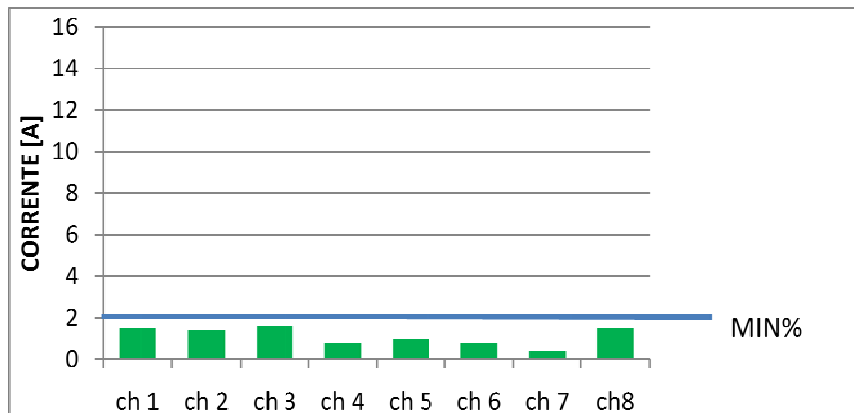


The channel ch3 has a current below the threshold. If this condition lasts for a time greater than TIME\_ALL parameter, the alarm condition for that string is set.

### Example 3:

The currents measured are:

ch1	ch2	ch3	ch4	ch5	ch6	ch7	ch8	channel
1,5	1,4	1,6	0,8	1,0	0,8	0,4	1,5	[A]



In this case the maximum current is less than MIN% (percentage of scale, 10% of 20A → 2A). With these values the comparison between the strings is not performed. In any case after two days of this situation the alarm of “null current persistence” is set.

### Customizations

Using the configuration software it's possible to modify a set of parameters on the String Box. In detail, other than the former three parameters (TOLL%, TIME\_ALL and MIN%), it's possible to change:

#### Daily and Yearly time masks

These masks have the purpose to disable monitoring during the day in those moments when it's shady on the strings.

It's possible to divide the year in two parts defining the starting date of each part to allow different behavior in monitoring. For each of the two parts of the year is possible to define an hourly-based time mask, ranging from 6:00 to 22:00 (21:59:59).



**NOTICE:** Please refer to the user's manual of the software for more details on the daily and yearly masks.

#### “Weight” of the measuring channel

Using the configuration software it's possible to change the “weight” for each measuring channel. This parameter has to be changed when a different number of strings or when strings with a different nominal current are connected to some channel. By default all the channels have a “weight” of 100.

Setting a weight of 50 for a certain channel, the String Box knows that on that particular channel a current of about one half than normal is expected during normal operation. This is a typical example of a channel with one string, while two strings are connected to the other channels.

With this parameter it's possible to monitor different channels with different nominal currents that would go into alarm condition if directly compared.

This is just an example: for each channel the “weight” can range from 10 to 100.

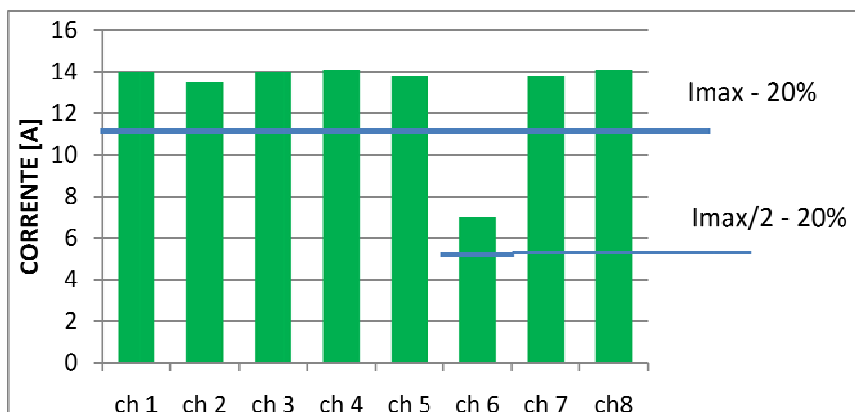


**NOTICE:** Please refer to the user's manual of the software for more details on the weight of the channels.

**Example:**

Channel 6 has "weight" 50, the others 100:

ch1	ch2	ch3	ch4	ch5	ch6	ch7	ch8	channel
14,0	13,5	14,0	14,1	13,8	7,0	13,8	14,1	[A]



The threshold for channel 6 is 50% compared to the others and so the condition is of normal operation.



**NOTICE:** If a channel has no strings connected, the "weight" should be set to 0 to exclude that channel from monitoring.

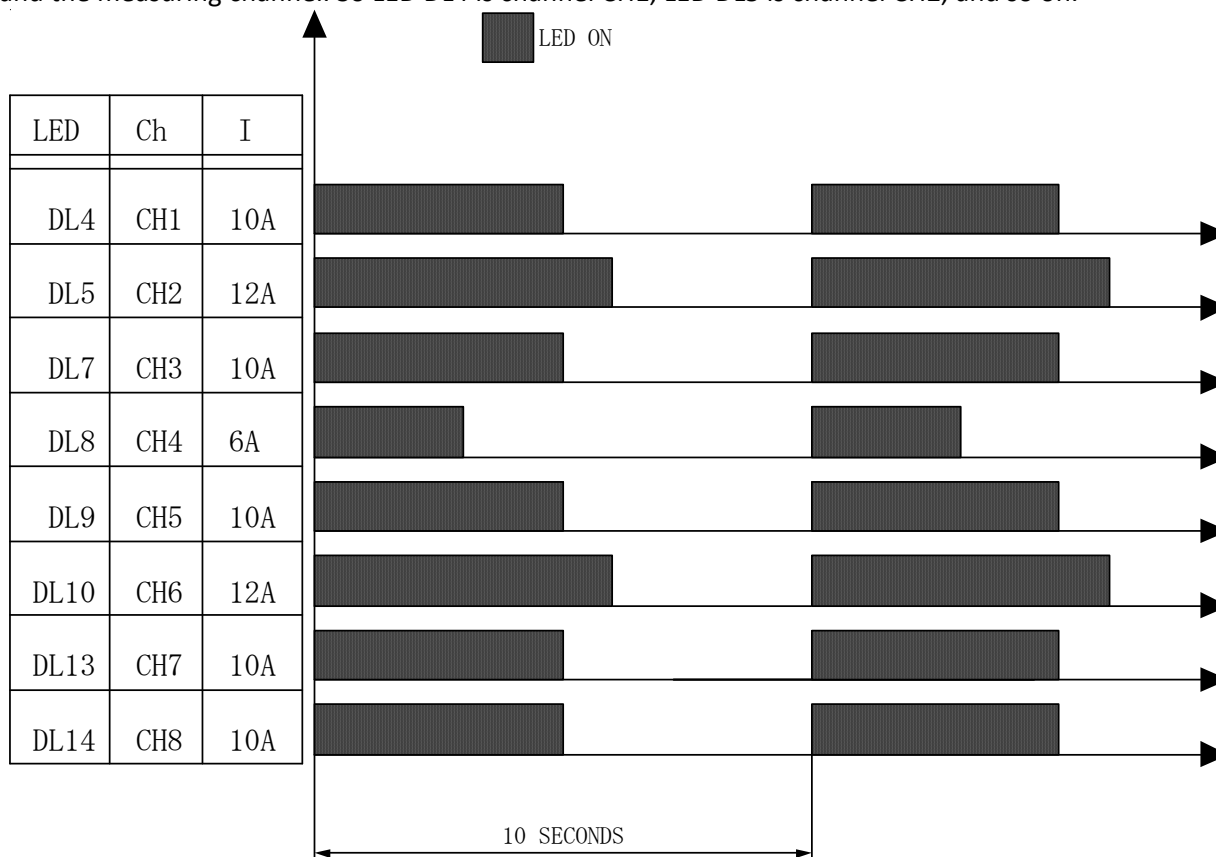
Alternatively you can set all the hourly masks of that channel to be unchecked to have the same result.

## LED behavior

On the microprocessor board there is a set of led; this set allows having a prompt visual feedback on 8 string currents.

The led corresponding to a channel stays lit for a time proportional to the measured current: so a measured null current is indicated by a led always off, a current to full scale (20A) is indicated by a led always lit, while a current of 10A (50%) makes its led lit for 5 seconds and off for the remaining 5 seconds. So the led flash with a period of 10 seconds and the duty cycle (lit time / unlit time) is equal to the measured current in relation to the full scale.

In the following figure there is a sample timeline representing led lit/unlit; the 8 channels of the sample String Box have different current, and in the same figure there is the correspondence between each led and the measuring channel. So LED DL4 is channel CH1, LED DL5 is channel CH2, and so on.



During operation, when the strings from PV field are delivering the same current, the LEDs will lit and unlit at the same time.



**NOTICE:** if one or more strings are in alarm condition, the corresponding led will flash with a 1Hz frequency.

DL15 led (ACTIV) indicates the normal operation of the board and flashes with a 2Hz frequency.

## STRING BOX: TECHNICAL SPECIFICATIONS

### General

Max input current	16 x 9A
Max output current	144A
Max voltage	880Vdc
Input screws	16+16 screw terminals
Output screws	2 bar clamps
Protection level	IP65
Operating temperature	-20°C ... +45°C
Insulation	2500Vac power/control

### Protection

Overvoltage discharger	<ul style="list-style-type: none"> <li>- Type 2</li> <li>- 1000V max</li> <li>- 40KA (total 8/20μs)</li> <li>- 12.5KA (nominal 8/20μs)</li> <li>- 25KA (max 8/20μs)</li> <li>- 3 varistors configuration</li> <li>- Self-protected with fuse</li> <li>- Monitored</li> </ul>
General output switch	4x125A (2 poles in parallel)
String fuse	20A 900Vdc 10x38
Auxiliary power fuse	4A 500Vac 10x38

### Alarms

String alarms
Null current persistence alarm
Overvoltage discharger alarm
Isolated digital input 1 status
Isolated digital input 2 status
Power supply voltage alarm
Real time clock alarm
Internal memory alarm
Link alarm (no connection to power board)
Calibration error
Auxiliary contact closed (tamper)

Communications	
Standard	<ul style="list-style-type: none"> <li>- 1 x RS232 (DB9 female)</li> <li>- 1 x RS485 (RJ45 + screws)</li> <li>- expansion communication slot</li> </ul>
Speed	- 9600 bps
Insulation	<ul style="list-style-type: none"> <li>- 2500Vac x 1 minute (232 e 485)</li> <li>- Slot NOT insulated</li> </ul>
Addressing	- From 1 to 127 (dip-switch selection)

Output relays	
Number of relays	2
Contact	<ul style="list-style-type: none"> <li>- Exchange/potential free</li> <li>- max. 2A</li> <li>- max. 220Vdc / 250Vac</li> <li>- max. 60W /62.5VA</li> <li>- resistance &lt; 35 mΩ</li> </ul>
Insulation	1000 Vac

Mechanical properties	
Dimensions(lxhxp)mm	600x840x300 mm
Weight	27Kg (59,52 lb)